Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/827
ISRAEL
February 1964
Submitted in: ENGLISH and FRENCH

Confidential until official release during Conference

Abstract

GENERALIZATION OF THE FERMI AGE THEORY AND ITS APPLICATION TO THE CALCULATION OF RESONANCE ESCAPE PROBABILITY

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A generalization of the Fermi Age Theory is obtained by replacing the expression $\xi \Sigma \varphi(u)$ - the slowing-down density - by the differential expression:

$$(1) \quad q(u) = \sigma_1(u)\varphi(u) + \frac{d}{du}[\sigma_2(u)\varphi(u)] + \frac{d^2}{du^2}[\sigma_3(u)\varphi(u)] + \ldots$$

The coefficients $\sigma_n(u)$ are defined by

$$(2) \quad \sigma_n(u) = \frac{1}{n!}\int v^n \sigma(u,v)dv$$

$\sigma(u,v)dv$ is the cross-section at lethargy u for a lethargy gain in the interval v, $v + dv$.

This expression for the slowing-down density q is obtained by expanding the collision density in the exact expression for q in a series and integrating term by term. The first term in (1) is Fermi's expression for the slowing-down density. Further terms describe the dispersion of neutrons in lethargy space during the slow-down.

The differential expression (1) for the slowing-down density may be applied in diffusion or transport calculations. We present results of resonance escape probability calculations obtained by truncating expression (1) after a few terms. The results are compared with other methods for calculating the resonance escape probability.

The method presented here has also been successfully applied to calculations of the slow-down of ions in a plasma.